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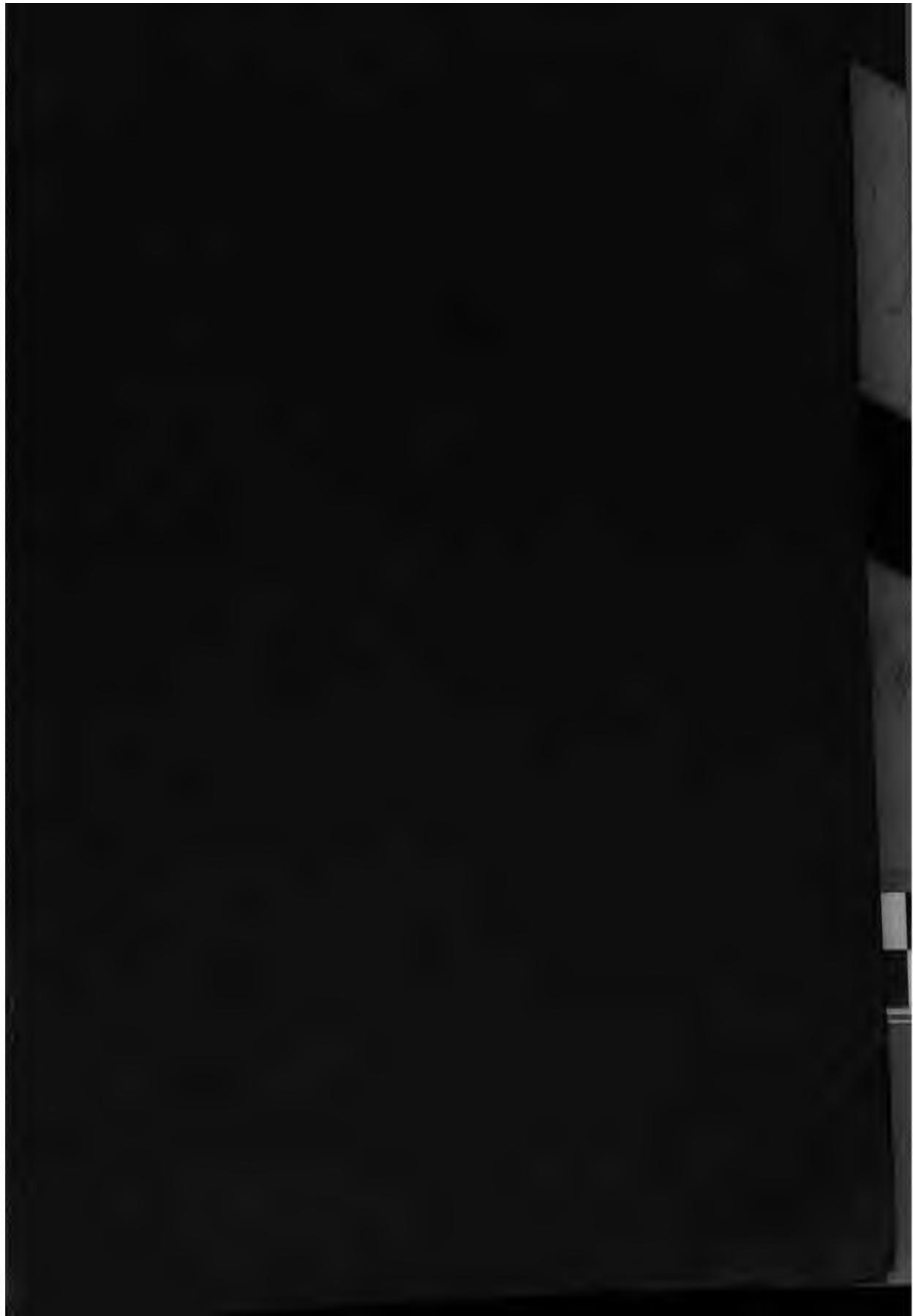
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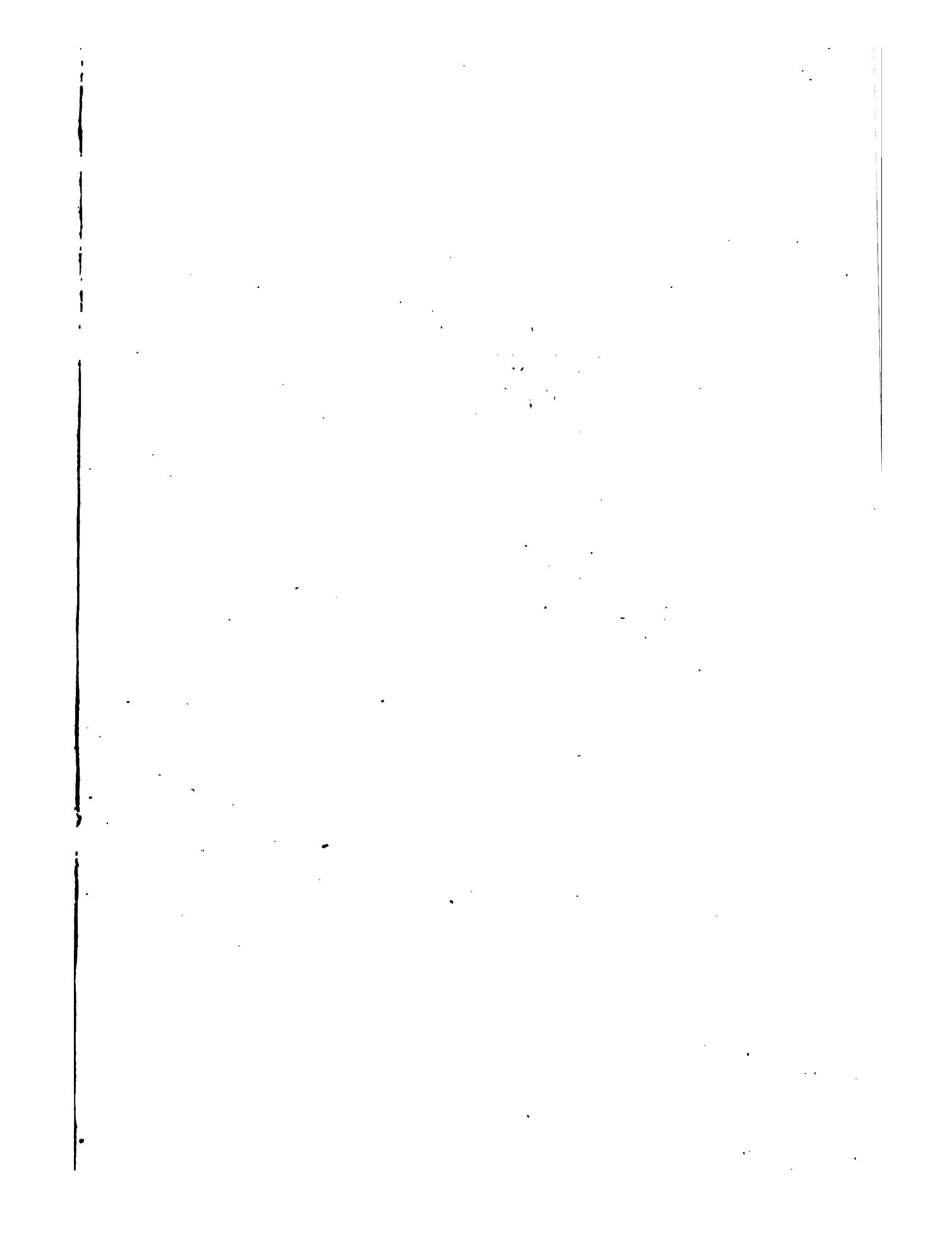


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*Chaplain  
Colonel*

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**EXTRACT**  
**FROM A**  
**MEMOIR**  
**UPON THE PASSAGE**

**OF**  
**RAPID RIVERS,**

*&c. &c. &c.*



**CAMBRAI:**  
**PRINTED AT THE MILITARY PRESS,**  
(BY SERJEANT BUCHAN 3d. FOOT GUARDS.)

**1816.**



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**EXTRACT from a Memoir upon the Passage  
of Rapid Rivers, &c. with a description of  
the construction, and method of application,  
of a new kind of Boats, proposed for that  
service, and an account of the experiments  
made with them.**

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**B**EFORE entering into a description of the new Boat or Buoy, which it is proposed to introduce into our Service, it may not be improper to observe that the Tin Pontoons, which form the Bridge Establishment generally made use of, are from their shape and other imperfections, very ill adapted to the passage of any rapid Stream. Without endeavouring to enumerate all the inconveniences or defects of the Pontoons at present in use, it is necessary here to advert to their leading imperfections, in order to contrast them with the new ones proposed, and to convey a more clear idea of the advantages of the latter. The Pontoons used as Boats separately are nearly unmanageable, as Rafts they are frequently immovable, (a) and always liable, (notwithstanding their air chambers) to be filled with water to such a degree, as to bring the platforms they bear upon a level with (or nearly under) the

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(a) Witness the Passage of the Adour below Bayonne.

water. In a Bridge they must be taken up as often as rain, or any other cause may have occasioned any considerable increase in the rapidity of the current, or at least if not taken up, the intervals between them must be increased to such a degree, as to deprive the Bridge of the power of supporting half the weight required.

When Pontoons are used even in the most moderate Stream, they must be placed so close for heavy weights, as to ensure both gunwales being pressed upon equally, otherwise they are in danger of being swamped by taking in water over one side, whilst the other is some few inches above the surface. It is therefore evident that on almost every occasion in actual service, although the Pontoon be calculated to displace 212 cubic feet of water when depressed to the utmost, yet it can never be made to displace above 170 cubic feet without the greatest risk, a depression of an inch more would often hazard the swamping of the Pontoon, and that in a violent current would probably lead to the carrying away by the stream of the whole of the Bridge; and even without that, the confusion and alarm which naturally arise from seeing the Pontoons fill with water, when the Bridge is loaded with Troops, or with Artillery, may occasion very disastrous consequences.

The weight of a Pontoon when new, is rated at cwt.9 - 1 - 24, but from the construction of it, an addition to the weight accompanies every repair.

Such are the principal considerations which gave rise to the idea of substituting a totally different kind of Boat, which should possess all the advantages of the Pontoon without its imperfections.

To enable the new Boat to bear an equal weight with the Pontoon, it was necessary that it should displace (when totally immersed) from 170 to 180 cubic feet of water, and as it is evident that every part of the figure which is not immersed, either in a Pontoon or in any other Boat, does not assist the buoyancy, but adds only a superfluous weight, it was deemed proper so to construct the new Boat, that it should admit of entire immersion without any of the risks which would result from the entire immersion of the Pontoon.

Upon these data in April 1815 a model was constructed upon a scale of one inch to a foot, it consisted of six Boats, each of such form and dimensions as to represent a cubic content of 196. feet upon a full scale, (b) But the whole being too small to enable an accurate judgment to be formed by it, another model was made in 1816, upon a scale of 6 inches to the foot, and the following is a description of it's construction, and of the experiments to which it has been subjected :—

The Bridge is composed of four Boats, each Boat consists of two cylindroconic buoys, connected by a frame, which frame constitutes the gunwale of the Boat when it is in the water, and forms the bolsters of it's carriage when travelling.—Plate 1, Fig 1.

Each buoy is constructed with 15 staves, 10 feet 6 inches in length, their breadth for 3 feet on each side of the centre, is 3 inches and a fractional part, and they

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(b) The first idea upon the subject suggested itself at Grenade on the Garonne, (and was communicated to Lieut. Colonel Dundas, then commanding the Royal Staff Corps, just before the Battle of Toulouse.) The model on an inch to a foot, was first began in September 1814.

taper afterwards towards both ends, where they are about half an inch wide; their thickness is about three-eighths of an inch, and they are cut out of wood of the specific gravity of fir. These staves compose the outer surface of the figure. The staves are bound together by 7 key'd hoops (Fig. 2, Plate 1,) in the cylindrical part of the buoy, and by 5 driving hoops upon each of its conical extremities, and although the hoops are capable of being so driven as to render the outer figure perfectly water tight, it is of no material consequence (as will be shewn hereafter) if it should leak at every joint.

An axis (Fig. 3, Plate 1,) of an inch and a quarter square, passing through three light wooden wheels, forms a part of the interior of each buoy, between the centre wheel and each of the others, a cylindrical box of tin is slipped upon the axis, (Fig. 4, Plate 1,) between each outer wheel and the end of the axis a conical box is fixed on, (Fig. 5, Plate 1,) thus every buoy contains 4 boxes, (Fig. 6, Plate 1,) and each boat eight.(c) It may at any time be put to the proof whether each of these boxes separately is perfectly water tight, by forcing air into it at the orifice marked (f.) in the Plan. This is an advantage not possessed by the air chambers of the Pontoon, which cannot be proved in this manner.(d)

(c) These Tin Boxes are about a quarter of an inch less in diameter than the wheels, by which means a small space is left between the Tin and the interior surface of the wooden staves, which secures the boxes more perfectly against injury by friction or any other accident.

(d) Supposing a leak or accidental hole in one of the partitions of the air chamber of the Pontoon, (if the Pontoon has any) it cannot be repaired without unripping the tin, either on the inside or outside; and after all the point where the leak originated may have been mistaken, and the whole work is then to be done over again.

The axis of the Buoy fitted with the 4 boxes and 3 wheels as above described, is terminated by 2 solid knobs to receive the points of the staves at each end of the Buoys; (Fig. 3, Plate 1, h.) the wheels are scolloped (Fig. 7, Plate 1.) to allow a free passage for any water which may have leaked into the Buoy, and which can be drawn off by means of a hand pump applied to a small opening in the Buoy, (Plate 7, Fig. 1, L,) and which has a corresponding channel in the tin box underneath it.

The whole interior machinery is kept steady by 4 narrow ribbands of tin, which are soldered here and there to the boxes, and fastened to the perimeters of the wheels; thus completing the interior of the figure. It is obvious that the number of boxes may be increased at pleasure.

Two buoys thus formed, and screwed into their frame, form one Boat; each buoy contains 10.5 cubic feet nearly, the two therefore contain 21 cubic feet, and they will require (exclusively of their own weight) 1160 lbs. (about 8 men) to immerse them completely. (e.)

The Boat having been described, the remainder of the Bridge requires no explanation, as it is not proposed to alter any of the usual appurtenances of the Pontoon, excepting the 9 chasses, for which 18 planks 14 inches wide are substituted, for the convenience of packing.

The following are the experiments made with the Bridge (the model) placed in open order, that is,

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(e) The complete immersion of the Buoys, does not only not affect themselves, but does not occasion any inconvenience on the platform of the Bridge, which is raised by the frame on which it rests, considerably above the upper part of the Buoys.

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the ends of the balks resting upon the outer gunwale of each Boat, the Boats being 7 feet 10 inches from each other, that is, from centre to centre; equal if the Boats were on the full scale, to 15 feet 8 inches.

In this state Infantry first passed it by Indian files, and next by ordinary files of 2 deep; from 20 to 30 horses were led over in succession, and no injury was sustained; the number of men upon the Bridge at a time was from 28 to 35.

The Bridge was again laid (Plate 2d. n n n n) with intervals of 8 feet 10 inches from centre to centre; (f) Infantry in file passed it in double quick time; horses were also passed without any risk; to put each boat separately under water, (while forming part of the bridge) it required immediately over it 10 men, or 1400lbs. (g.)

The Bridge was next laid (Plate 3d. P. o o o o) in the order that Pontoons are commonly placed, the balks covering two boats, and resting on one gunwale of the 3d. Boat: the Bridge was in this instance constructed with 4 of the new Boats, and one ordinary Pontoon, made upon the same scale; No 1 Boat (Plate 3,) having the distance between it and the shore, greater than the other intervals of the Bridge, was immersed with the weight of 10 men or 1400 lbs. The interval between 1 and 2 sustained 14 men or 1960 lbs. (h.)

No. 2, required the weight of 18 men or 2520lbs. to immerse it completely.(i)

(f) 17 feet 8 inches when the Boats are on full scale.

(g) Equal if the Boats were on full scale to 5 tons.

(h) Equal to 7 tons on full scale.

(i) Equal to 9 tons,

No. 3, required the weight of 17 men or 2380lbs. (k)

No. 4, was too near the shore and in water too shallow to try its power.

The Pontoon (P. Plate 3,) constructed also upon 6 inches to the foot, and weighing in proportion, that is one eighth of the weight of a Pontoon upon full scale, bore (but with the greatest risk) 14 Men or 1960lbs, being pressed down close (or nearly) to the water's edge all round. (l)

The whole bore with ease, and without risk, (as far as regarded the new Boats) a carriage upon a proportionate scale, to pass and repass, loaded with 10 Men or 1400lbs. (m) but the Pontoon with this weight in motion upon the Bridge, took in water at the gunwale which first received the pressure, and would have swamped in any other than in smooth water.

As a last and most satisfactory experiment, the Pontoon (P) was removed to the place of No. 1, and No. 1, to the place of the Pontoon, in which situation No. 1 bore an addition of 140lbs to the weight sustained by the Pontoon in the same place, and that without risk of destroying the Bridge, or interrupting the communication. From these experiments it is evident that 170 cubic feet is sufficient for the content of one of the new Boats upon the full scale.

(k) Equal to 8 tons 10 cwt.

The difference between the power of 2 and 3 may be ascribed to the latter being furnished with the tin boxes, which the former was not.

(l) This experiment was made in still water.

(m) Equal on full scale to 5 tons.

One (*n*) upon the full scale has been constructed, which from the swell given to the cones of it's Buoys, contains 173 cubic feet, nearly, and to immerge it completely requires 89cwt. it's weight was calculated before it's construction, thus:—

	lbs.
Sixty Staves, ... ... ... ...	480
Hoops, ... ... ... ...	104
Tin, ... ... ... ...	180
Axis and Wheels, ... ... ...	80
	<hr/> 844

or Cwt. 7 - 2 - 4 (*o*)

This Boat tho' calculated to be made of dry or seasoned wood, was in fact constructed of green timber, and when first put together it weighed exclusively of the tin, and prior to the staves being dressed off either within or without, 723lbs. being only 59lbs. above the estimate; a proof that with proper materials, and due attention, the Boat might be constructed so as to weigh less even than at first conceived.

It remains yet to say something upon the experi-

(*n*) Composed of 20 staves.

(*o*) Cwt 7 - 2 - 4, being thus about 2 cwt. lighter than a Pontoon; for the frame which connects the Buoys of the new Boat, being in fact part of the carriage, it's weight can only be counted once, if it be added to the Boat, it must be deducted from the carriage, which having only to support cwt 7 - 2 - 4, might be altogether 1 cwt. lighter than that attached to a Pontoon; making a total difference of 3 cwt. near'y in the complete equipment of each Boat, in favour of the new construction, thus,

Comparative weight of the Pontoon and new Boat,

	Cwt. Qr. lbs.		Cwt. Qr. lbs.
Pontoon,	9 1 24	New Boat,	7 2 4
Appurtenances, 19 0 9½		Appurtenances, 19 0 9½	
Carriage, 12 3 19		Carriage, 11 3 19	
Difference, 2 3 20		Total, 41 1 24½	<hr/> 41 1 24½
Total, 41 1 24½			

ments with these Boats, when used as Rafts or flying Bridges.

Two of the new Boats were placed (Plate 4. q q) as in the Bridge in open order, (Plate 2.), that is, the balks resting on both gunwales of each Boat, the Pontoon (P) was placed in the centre between them, and this Raft loaded upon one occasion with 7, and afterwards with 9 Men, was forced by paddles up the stream of the Scheldt, into the eddy of a violent rush of water, let out purposely from the sluice gates of a mill dam; the Raft was then brought by paddles into the middle of the current, where it was moored fast, and continually enveloped in the stream; the Pontoon was filled with water in a few minutes, and the lashings being cut, it was allowed to go adrift; the remainder of the Raft continued unaffected by the current, and when unmoored it was swept by paddles to the shore, and the Men landed without any danger having been experienced. (p)

As a flying Bridge, the same 2 Boats were employed on the 21st. of October, below Denain during several hours; they were anchored in the middle of the stream, the cable shifted from one corner to the other as required, and a sweep rudder employed to throw them upon the necessary angle.

The materials for constructing a Bridge on the following morning were all carried across the River by these means, and at one time 12 Men (q) were upon the flying

(p) These experiments have been repeated before all the principal Officers of the Army, who could well judge what would have been the probable fate of men upon a raft of Pontoons only, in such a situation.

(q) Equal upon full scale to 96 men.

Bridge, and were conveyed with perfect safety, from one bank of the River to the other.

A third Boat being placed under the centre of the flying Bridge, it conveyed 21 Men, equal on the full scale to 168 Men.

The last thing to be considered is the repair of the Boats in question; if the outer figure only be damaged, it can be repaired with ease, by splicing or plugging the injured staves; if the interior figure be damaged, it has been proved by experiment that nothing is more easy than its repair: the hoops towards one of the ends of the Buoy are knocked off, (Plate 7. Fig. 1.) as also the last hoop at the opposite end, and the whole interior figure is drawn out; the injured box is then slipped off the axis, if necessary, or repaired where it stands, which being done, the whole is replaced, and the ends of the Buoy again closed by the drift hoops.

It may not be amiss when speaking of the facility of repairing such Boats, to say a few words upon the facility of their original construction, both with regard to time and place. One of these Boats was completed in little more than 2 days, by two ordinary Carpenters, (not Coopers) and two Blacksmiths, and the whole Bridge was constructed in great measure in the field; the wood was bought green and worked up scarcely under cover; the iron work was done with the assistance of a common field forge, and absolutely in the field. (r)

The model it must be observed exceeds in every point the weight it should have, (s) a circumstance un-

(r) The cause of this was that Forges could not be worked in the Villages about Cambray where all the Houses are thatched.

(s) The tin for example is as thick in the model as it is required to be in the Boat on full scale.

voidable, for in the first place, had the materials been all in proportion, they would not have borne the rough experiments to which it was necessary to expose them, and secondly, the model besides being considered merely assuch, was actually converted to real use, and one cannot perhaps better conclude than by stating that it was applied to the purpose of a Bridge on the 22d. of October, it was laid across the Scheldt below Denain for the passage of Troops, and was first passed by the Light Companies of the 6th. Brigade, it was afterwards examined by their Royal Highnesses The Dukes of Kent and of Cambridge, by Count Woronzow, and General Zieten, and numerous other Officers, and appeared to give general satisfaction.

It seemed to carry with it the conviction, that whatever imperfections these new Boats may otherwise have, a Bridge constructed of them could never be swamped by a rapid current, and that even if over-loaded for an instant it would rise again as soon as relieved from the pressure; whereas Pontoons under the like circumstances could not recover themselves, and the communication they afforded would therefore be interrupted, and the Troops on the opposite banks separated from each other.(t)

The large Boat, as well as the model Bridge, was seen by His Grace The Duke of Wellington, on the 25th. October; the Bridge on that occasion was thrown across the Scheldt in 27 minutes, by men little accustomed to that service; the four Boats composing the model Bridge with their proportion of balks and planks for 50 feet span,

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(t) That this may occur was evidenced on the Guadiana during the siege of Badajos, and also at the passage of the Garonne near Toulouse.

were transported from Cambray to Denain, on the 19th. October, upon one light Commissariat Waggon, one pair of horses drew them without difficulty, and two pairs were evidently more than sufficient.(v)

A material advantage perhaps of these Boats is the facility and privacy with which they may be transported, for instance, the staves and hoops once made may be packed in long cases made of the planks of the Bridge, and need never be put together until a few hours before the Bridge is wanted. The tin boxes of the interior of the Buoys might upon an emergency be dispensed with, and a march might thus occasionally be stolen upon an enemy, while he was in imaginary security, from the idea that a Bridge establishment did not exist in the suite of the army whose operations he was watching.

I. R. COLLETON, Major,  
Captain, Royal Staff Corps.

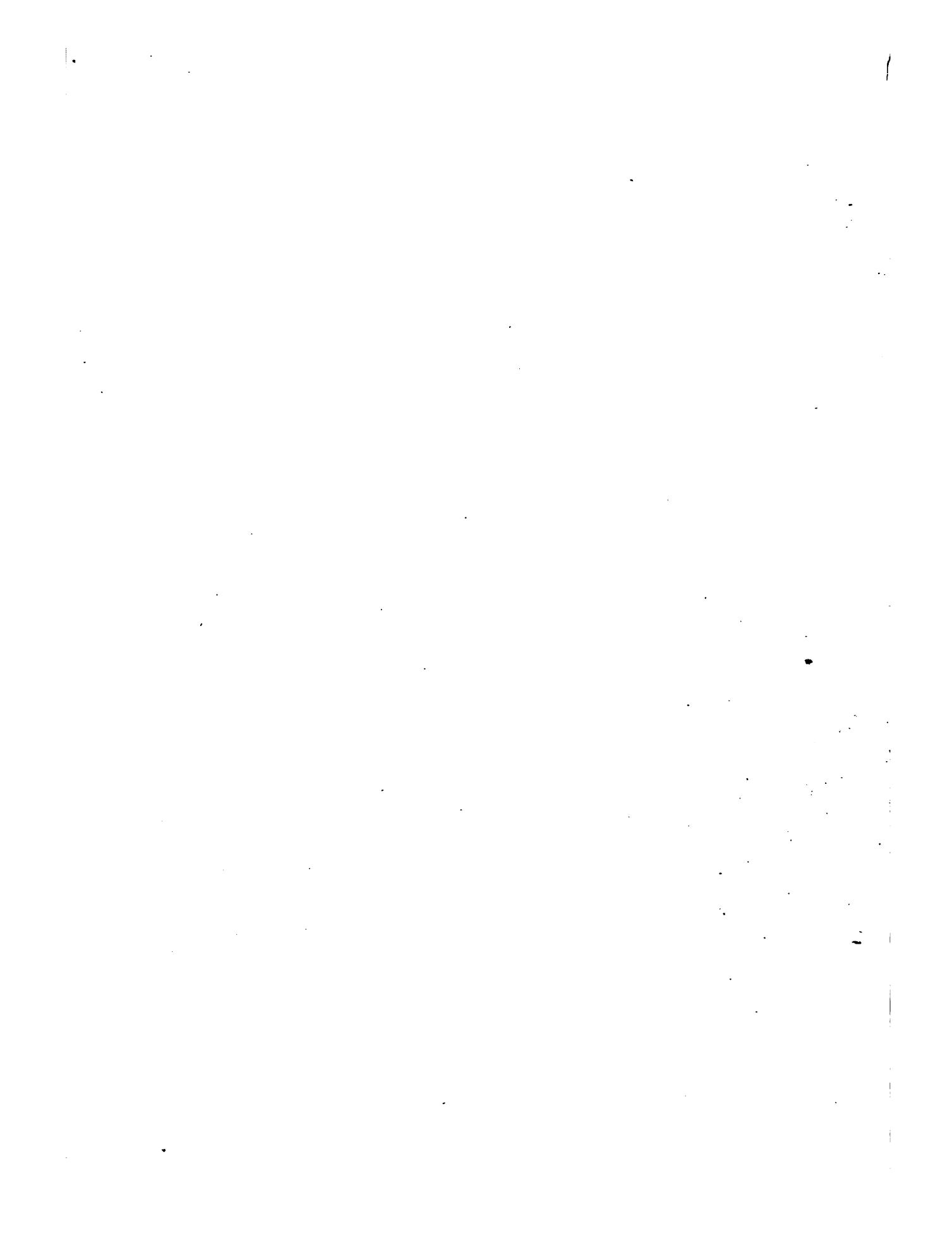
*Cambray 28th. October 1816.*

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(v) From this it may be inferred that a Bridge for Infantry and Horses, might be conveyed at the rate of 100 feet of span for every 6 Horses; in situations unfit for carriages the Buoys of the small Boats could be separated and easily carried either by men or on mules; even the large Boat and frame being composed of 3 parts, could be conveyed without much difficulty in situations where no common Pontoon could be carried.







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